Final Project. Due: May 1

Pick one of the following topics and write a report based on your investigation and findings. The report should include:

- An introduction to the scientific problem/dataset
- Sufficient mathematical and statistical details on the methods used to analyze the data or solve the problem that someone else could reproduce your analysis
- Relevant plots, tables and diagnostics to support your modeling choices
- A discussion summarizing your report along with potential future research directions
- Code input/output should be included in an appendix, not in the main report body.

Confirm your project with me, by e-mail, by Monday, April 8. Possible projects include:

- Analyze a scientific dataset of your choice.
- Choosing the weight matrix in SAR/CAR models is of fundamental importance. Investigate and report on some of the possibilities in Chapter 9 of Bivand et al. (2013).
- Zimmerman and Zimmerman (1991) compare various methods of parameter estimation; implement your own study and compare to their results.
- Look into one of the simulation methods discussed in class in detail (Lantuéjoul and Desassis, 2012; Gneiting et al., 2006; Mantoglou and Wilson, 1982; Matheron, 1973; Schlather, 2012; Shinozuka and Jan, 1972).
- The R package spBayes is designed for doing Bayesian statistics on spatial problems. Write a tutorial with small examples and code for using the spBayes package for your professor.
- Write your own code to do Bayesian kriging on a dataset and compare your solution to that generated by the R package spBayes.
- Investigate space-time processes. How are covariances defined? What are some useful models? How would you go about exploratory data analysis?
• Look into the theory of maximum likelihood for spatial processes, including some bizarre consequences of different asymptotic regimes (Mardia and Marshall, 1984; Zhang, 2004).

• Explore likelihood computation techniques for large datasets (Stein et al., 2004; Furrer et al., 2006; Fuentes, 2007).

• Investigate the details of choosing priors for a Bayesian approach to spatial problems (Berger et al., 2001).

• Spectral estimation for spatial problems can yield surprising results under infill asymptotics, review the fundamental paper by Stein (1995).

• Nonstationary modeling forms a large part of spatial statistics; review the work of Paciorek and Schervish (2006).

• Investigate the theory of point processes.

• Recent work has focused on spatial processes generated by stochastic partial differential equations, review the landmark paper by Lindgren et al. (2011).

• Investigate the origin of the Matérn class of covariances (Guttorp and Gneiting, 2006).

• Multivariate processes are playing an increasingly important role. Compare the ideas of Goulard and Voltz (1992) and Gneiting et al. (2010).

• Low rank approximates have become relatively popular in the last decade (Cressie and Johannesson, 2008; Banerjee et al., 2008), but come with some problems (Stein, 2014).

• There are intimate links between the theory of splines and spatial process models, discuss some connections (Wahba, 1978; Furrer and Nychka, 2007).

• Pick another topic from the course or related to spatial modeling that interests you (see me to get relevant related articles).

References


